Specific Characters and Character Variants in Adults and Larvae of the Genus *Paratrombium* Bruyant 1910 (Acari, Trombidiidae), with Descriptions of Two New Species from Western North America

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The genus *Paratrombium* was established by Bruyant for a larval mite, which he named *P. egregium*, found in a vial containing Diptera, Coleoptera, and possibly other insects. The outstanding characteristics of this larva as indicated in the drawings provided by Bruyant were: (1) the large postscutal dorsal plate, (2) the characteristically striate anterior portion of the scutum, (3) the form and orientation of the heavy, sharp prosensillar setae which appear to arise from the end of long canals, (4) the swollen, bilobed tip of the rostrum, (5) the elongate, pectinate tritorostral setae, (6) the heavy rakelike inner setae of coxae I, (7) the presence of a single pair of intercoxal setae, (8) the number (four) and orientation of the setae between coxae III and the anus, (9) the presence of only two scythe-shaped claws on tarsus III. In all of these features, the species described by Bruyant resembled so closely the one described below as *Paratrombium bidactylus* n. sp. as to indicate that these are congeneric.

It should be pointed out that the original description of *P. egregium* differs from *P. bidactylus* n. sp. in three important respects: (1) the presence of a pair of slender, elongate setae between the sensilla and prosensillar setae of the scutum, (2) a coxal setal formula in the larva of 2-1-1 compared with 2-2-1 in *P. bidactylus*, and (3) the possible absence of the four characteristic elongate setae at the posterior margin of the body. The first of these apparent differences is based on an artifact; for the transverse suture which partially divides the scutum into anterior and posterior portions appears so sharp and delicate that Bruyant unquestionably mistook it for a fine seta. With regard to the second of these characters it should be pointed out that Oudemans (1910) represented this species as having two setae on each of coxae II of the larva; and moreover showed only four pairs of setae on the scutum, including the single pair of sensilla. Oudemans' somewhat more detailed figures were apparently prepared from Bruyant's own material, hence, the original description of *P. egregium* was in error on this point also. With regard to the third point mentioned above, neither Bruyant nor Oudemans showed the characteristic setae at the posterior end of the hysterosoma which are found in the larvae of *P. bidactylus*. It should be pointed out, however, that the writer's drawings have been made from unengorged larvae while those drawn by Bruyant and Oudemans were of engorged larvae. Both Bruyant and Oudemans showed a total of 28 postscutal and postcoxal setae whereas in *P. bidactylus* there are 30. This could be a true specific difference or it might possibly be due to the loss of one of the pairs of setae during the period of feeding in the specimens from which the available figures of *P. egregium* were drawn. At any rate, the close morphological similarity between *P. egregium* and the two species described below as *P. bidactylus* n. sp. and *P. quadriseta* n. sp. is so close as to indicate beyond reasonable doubt that they are congeneric.

The differences between the two larvae described below appear to be adequate to indicate that two distinct species are involved, and since they were obtained from known adult females, it is possible to determine what adult characters, if any, show variations of a

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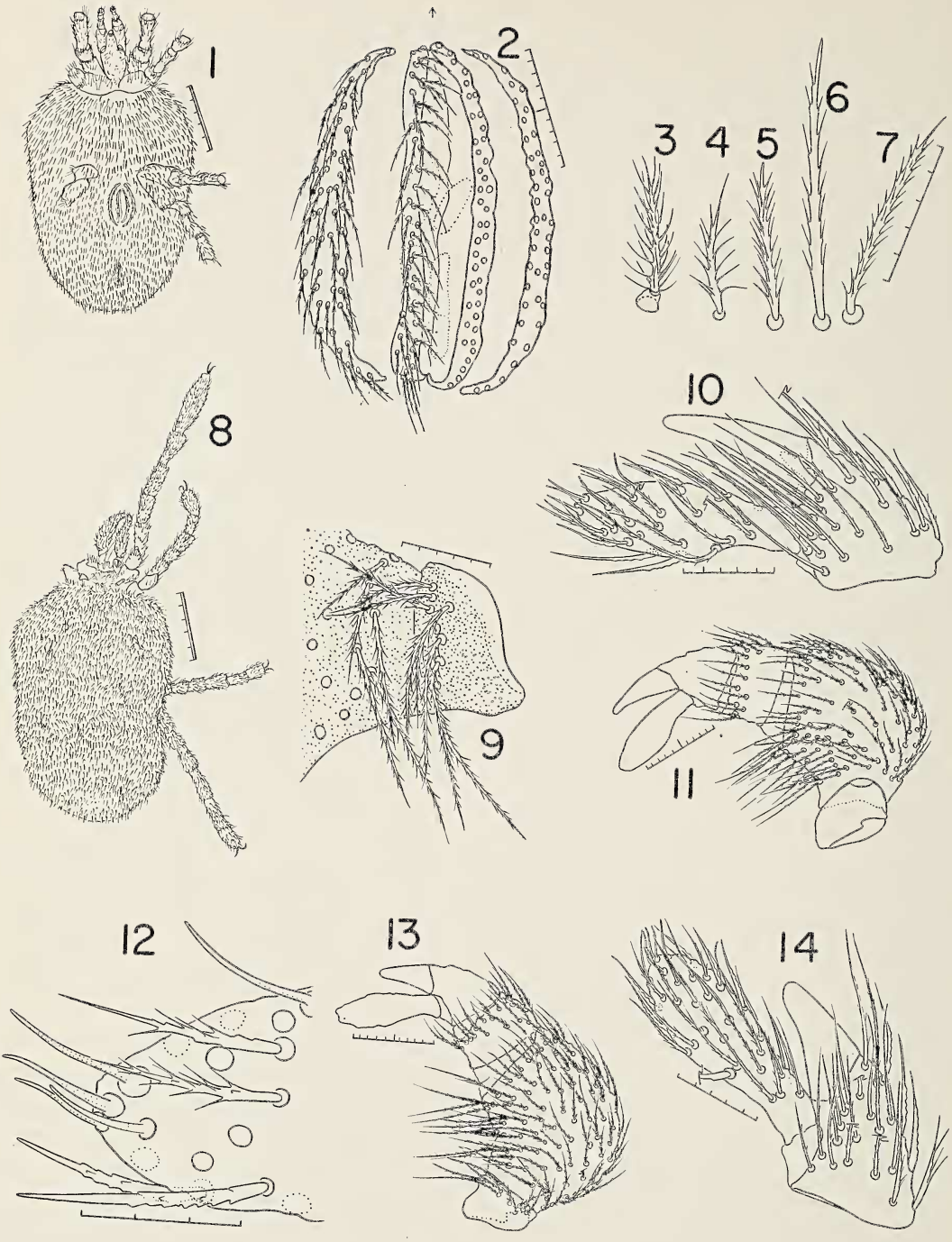
possible specific nature. Correlations between larvae and adults in this group are much needed, because the two instars are often collected under quite different circumstances, with the adults coming from general collections, and the larvae often being found on their insect hosts. Because of the great change in form which accompanies the transformation from larva to nymph and nymph to adult in the Parasitengona, it is impossible to correlate larvae and adults with certainty by any means other than rearing.

There are even more compelling reasons, however, for establishing correlations between larvae and adults. In the first place, adults within a given genus of the Parasitengona are separated from each other by characteristics largely of a relative nature. The intraspecific variation in the adults of these mites is so great that it has not yet been adequately analyzed for any single species within the entire group. At the same time, *interspecific* differences are relatively small, so that in examining two adult specimens within a given genus, which show moderate differences, there is always the question of whether these differences are of a specific nature, or whether they fall within the range of variation of a single species. The primary difficulty here is that the chaetotactic differences which are of such great value in separating orthotrichous forms are almost totally unavailable in the highly neotrichous Parasitengona. With intensive study of the chaetotaxy of adults, exceptions to this are slowly coming to light, but they are at the present time very few in number, and it appears increasingly likely that there are certain genera in which absolute chaetotactic differences will never be of great importance in differentiating species. While it is to be hoped that it will never be necessary to have *both* larvae and adults in order to provide positive determinations of species, there is no assurance at this time, in the present inadequate state of our descriptive accounts of the adults of these species, that such will not be the case. Old species must be carefully redescribed, and new species must be described in considerably greater detail and with far greater accuracy than they have been in the past if we are to progress in knowledge of the adults as far as we have in knowledge of the larvae.

In the second place, correlations between larvae and adults are necessary in order to provide additional information upon which to determine relationships within the Parasitengona. In very many cases, the best generic characters are found within the larvae, and in any case it is always well to have the larval characters in addition to the adult characters in arriving at conclusions concerning relationship. Here again, it should be pointed out that even recent descriptions of larvae of Parasitengona are inadequate from a morphological and systematic standpoint. All too often, for example, the chaetotaxy of the palpi is presented in a very sketchy manner, if at all, and the segments of the legs, despite their greater size, come out only slightly better. At the species level, detailed studies of the larvae of closely related species are desirable in order to substantiate the validity of minor differences suspected of having specific value in the adults. For example, in the present case, there are a few very minor differences between the adults of *Paratrombium bidactylus* and *P. quadriseta*. If one had only the adults of these two species, there would be considerable doubt whether the differences in eupathidial counts on the palpal tarsus, the slight difference in the posterior end of the crista metopica, the chaetotaxy of the anterior portion of the scutum, and the number of setae on genital and paragenital sclerites were of real specific value. It is still possible that studies of additional adults will show these characters to intergrade at least in part. Yet the studies of the larvae show clearly enough that we have two distinct species, hence any differences found between adults of these two species are of possible specific value, and are worth investigating in detail.

In the present paper, the terminology uti-



FIGS. 1–14. *Paratrombium bidactylus* n. sp., female: 1, venter, female; 2, genital opening; 3, typical seta posterior and lateral to anus; 4, seta from genital sclerites; 5, seta from intercoxal area; 6, seta of coxa II; 7, seta behind the coxa II; 8, dorsum; 9, trochanter of palp, posterior; 10, tibia and tarsus of palp, anterior; 11, entire palp, anterior, chaetotaxy of tibia and tarsus omitted; 12, tip of palp, posterior; 13, entire palp, posterior; 14, tibia and tarsus of palp, posterior.

lized in the earlier work on the Johnstonianidae (Newell, 1957) has been followed, as has the convention for designation of the positions of setae on the segments of the appendages. The decimal system of notation has been extended to the scutum as well as the appendages. In the case of the scutum, the starting point (0.00) will be the most anterior point on the median line of the scutum. In *Paratrombium* and many other genera, the anterolateral lobes of the scutum actually extend beyond this point, but since these are rather poorly defined in some genera or in particular specimens of many species, it is better to utilize the more readily recognizable point. In general this will be the most anterior point on the median axis of the scutum, regardless of whether or not this is precisely the anterior end of the entire plate.

Attention should be called to the indiscriminate use of the term crista metopica. This term was applied by early authors to the very pronounced ridge which runs longitudinally over the dorsum of the propodosoma of many species of the Parasitengona. It is primarily a strengthening support for the dorsal wall of the propodosoma, and also provides attachment for certain of the muscles of this part of the body. It should be kept in mind that the crista metopica is only one part of a larger sclerite, the scutum, which is of considerably greater significance both structurally and taxonomically than the crista metopica alone. The crista metopica, because it is so much more conspicuous than the scutum (the margins of which are often so faint as to be detectable only in carefully dissected and mounted material), is often described as though it were an isolated structure in itself. In a few of the Parasitengona it does approach this status, especially in some of the larger Erythraeidae in which the scutum is only very slightly broader than the crista. At some points the crista in certain genera may even be the *only* portion of the scutum to be found. However, such cases are extremely rare; and there are few species in which the scutum does not extend at least somewhat beyond the limits of the crista metopica. The neglect of the peripheral portions of the scutum in descriptive accounts is a serious omission. It is also a mistake to extend the term crista metopica to apply to the scutum as a whole. A description of the scutum should be based upon dissected material, or if this is impossible, upon carefully compressed specimens in which all levels of the scutum are lying in approximately the same plane.

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PARATROMBIUM Bruyant 1910

ADULT: Trombidiidae of medium to large size, and brilliant red color. Scutum with sensilla in middle one-third of plate, widest portion of scutum at anterior end; crista extending from posterior end of scutum to a group of setae near the most anterior point on the midline of the scutum. Eyes distinctly stalked, two corneae on each side. Dorsal hysterosomal setae all of one type, peripectinate, arising from small, erect, conical papillae. Coxal rings I and II open dorsally, a long slender supracoxal seta on I. Genital and paragenital sclerites both well developed and bearing numerous peripectinate setae; three pairs of genital acetabula. Tarsus of chelicera bearing a row of minute denticles along the upper margin, this row of denticles also continuing down over the side of the basal portion of the tarsus (Figs. 22,

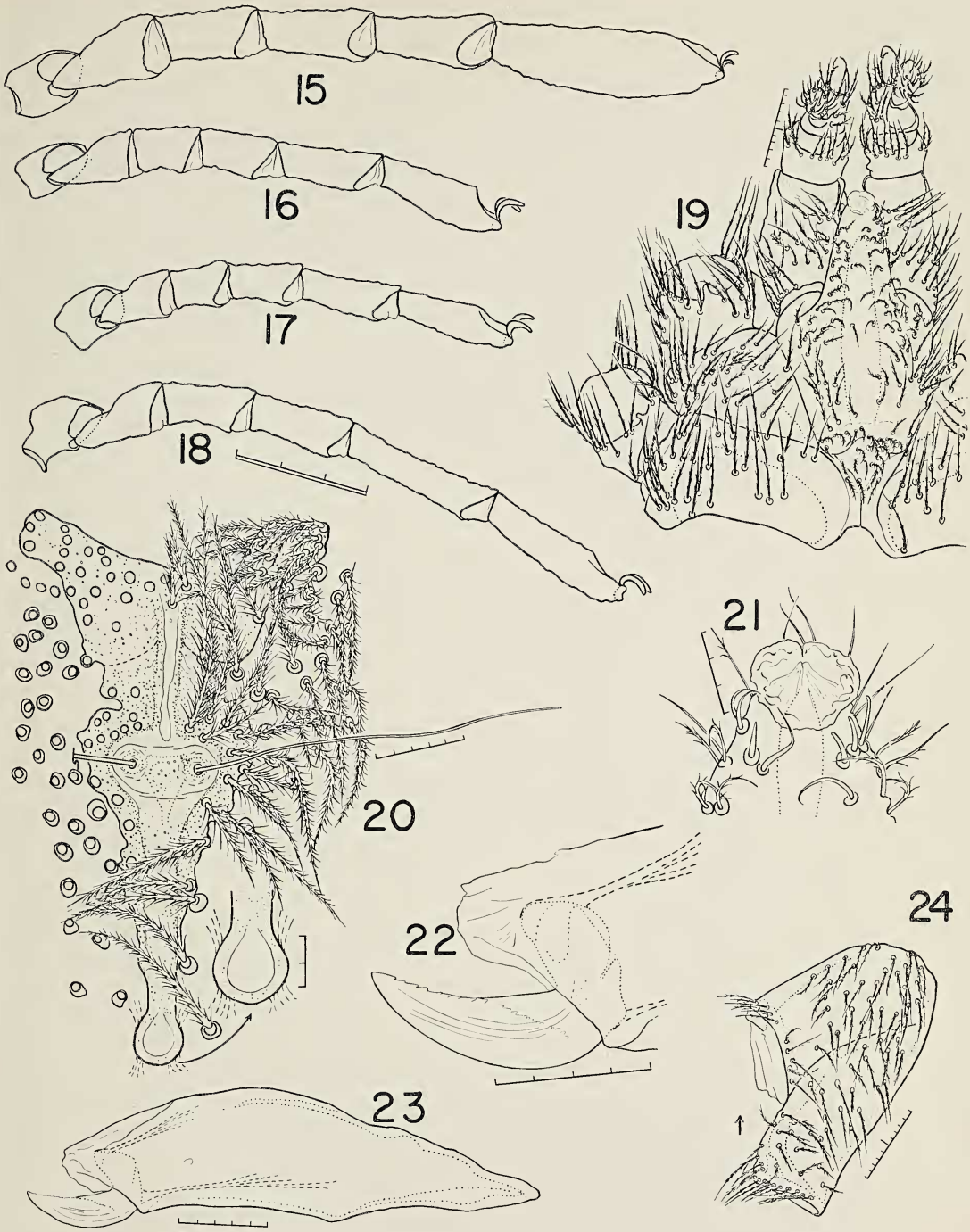
55). Palpi of normal form for family, odontus unidentate, paradont absent. Tibia with no clearly defined ctenidium, but with a group of unusually smooth setae anteroventrally, near the insertion of the tarsus. Tarsus with a single solenidion posteriorly and a variable number of eupathidia.

LARVA: Scutum with four pairs of setae, postscutum with two or four pairs; postscutum nearly as wide as scutum. Coxa I with a slender supracoxal seta and two ventral setae, the medial one of which is greatly enlarged and bears a number of long, fingerlike teeth on the posterior margin. Urstigma very large, concealed under the posterior margin of coxa I in ventral view, visible only by transparency. A single pair of intercoxal setae. *Lassenia*-organ present. Palpi with only four segments visible in ventral view, but trochanter present as a very small plate dorsally on base of palp (Fig. 40). Palpi oriented so that the morphological dorsal line forms the lateral margin of the palp as seen in dorsal or ventral view. Trochanter and patella devoid of setae, femur with a single seta. Tibia with a deeply cleft odontus plus three simple setae; no specialized paradont present. Tarsus reduced to a small hemispherical cap bearing a number of setae of variable size and form, but one of these is strongly scythe-shaped. Rostrum with only the protorostral and tritorostral setae. Basifemur and telofemur of all legs fused. Solenidial formula of patella (2-1-1), of tibia (2-2-0), and of tarsus (1-1-0). Vestigial setae present on patella I and II and tibia I, famulus on tarsi I and II; companion setae absent. Tarsi I and II with three claws each, III with anterior and median claws of same form as on I and II, but with posterior claw reduced to a very short rudiment (at least in the type species and the species described in this paper).

CHARACTERS SHOWING INTERSPECIFIC VARIATIONS IN THE GENUS *Paratrombium*

Although the study of interspecific variation within a genus is of practical value in the identification of species, this should never be regarded as the sole purpose of such studies. Any type of variation observed, whether of practical utility in a key or not, should be investigated as it may indicate relationships within the genus, or evolutionary trends. When combined with similar studies in related genera, they provide information on whether or not the same types of adaptive changes have occurred in different genera. In the large Parasitengona, intensive studies of variation are even more important than in the other genera, because the differences separating species are more often of a purely relative nature; that is, they involve variations of continuous rather than discontinuous types. As a consequence of the studies of the two forms described here, a number of characters were discovered which show variations of possible specific value. These are summarized below, the characters for adult and larva being listed separately. Most of the character variants listed in the tables are self explanatory, but some require further explanation. Most of them show variation of a continuous type. One exception is found in the dorsal chaetotaxy of the larva, in which the postscutum has two setae in one of the species and four in the other. These variants are discontinuous only in the sense that no intergradations between them have been found up to the present time. While it is not inconceivable that these exist, it is interesting to note that the closest approach is found in occasional specimens of *P. bidactylus* in which there are two setae on one-half of the postscutum. Even in these cases, the half of the postscutum in which the duplication has occurred does not resemble its counterpart in *P. quadriseta*, since the placement of the two setae is markedly different.

The variations in form of the hysterosomal setae (character 14, adult) are more or less discontinuous, although it is quite certain that many gradations will be found when the genus is more adequately known. If Feider's assumption (1952) that nearly all species of



FIGS. 15–24. *Paratrombium bidactylus*, n. sp., female: 15–18, legs I to IV; 19, gnathosoma and propodosoma, ventral; 20, scutum of dissected female; 21, tip of rostrum, ventral; 22, cheliceral detail; 23, chelicera; 24, coxae III and IV.

the old genus *Dinothrombium* actually belong in *Paratrombium* is correct, the probability of intergradation in setal types is very great.

Nearly all of the characters listed below show variants which are useful in distinguishing the two species under consideration here. It is to be expected that as more species are adequately described even more characters and variants can be added to this list. At the same time, as other populations of the two species involved are studied, the range in variation of the characters will become greater. The variants of the characters are summarized in the form of a formula key. The purpose of such a key is not so much the identification of species, as to provide a convenient means of summarizing the observed ranges in the character variants. Of course, species identification can be made simply by selecting certain of the more easily interpreted characters and determining the particular variant of each character which is found in the specimen or specimens at hand. In the case of the adult, the most easily interpreted characters are 1, 3, 6, 12, and 14. Few larvae have been described at the present time so that it is impossible to say what will be the most reliable characteristics. In the case of the two species described here, the form and chaetotaxy of the postscutum, and the position of s_1 (characters 1, 4, 10, 11, and 12) are the most easily applied. So far as the present data are concerned it must be remembered that the measurements shown in the tables of distribution of character variants in the case of the larva, are based upon the progeny of a single female, and the variation of the species as a whole must be greater than that shown in the table. In the case of the adult only one specimen in each case was involved; where a range is indicated, this is based on the variation on right and left sides of the one specimen. This is admittedly undesirable from the standpoint of an analysis of variation in the species, but at least it is a beginning and shows the probable direction which future attempts at the measurement and expression of interspecific and intraspecific variation should take in *Paratrombium* and related genera.

Characters such as the number of setae on each anterolateral lobe of the scutum of the adult are likely to be quite variable and to show intergradation between similar species. Nevertheless, it is obvious that the number of setae on the scutum will still be of value in separating species which are markedly dissimilar with respect to this character. The same is true of such characters as the number of setae on the genital and paragenital sclerites, the number of eupathidia on the palpal tarsus, and the proportions of tarsus I and tibia I. Characters dealing with the positions of setae on the leg segments have seldom been used in the differentiation of species, nor should they be used critically unless some work has been done to assess their variability in a series of specimens. A study of characters 4, 5, 6, 7, and 8, dealing respectively with the positions of s_1, e_d of tarsus I, f_1, s_2, and f_2, shows that in all of these cases the distribution of these setae overlaps in the two species. However, the mean positions show some variations which are certainly significant for the material studied, and probably for the species as a whole. Thus, while f_1 and e_d are at essentially the same level in the two lots of larvae studied, s_1 is considerably more distally placed in *P. bidactylus*, and the range in position of this seta in the two species barely overlaps. The same tendency toward distal placement of s_2 and f_2 in *P. bidactylus* is also seen, although the ranges overlap more than in the case of s_1.

In the tables of distribution of character variants, those variants given by Feider (1952) for *Paratrombium divisipilli* Feider 1948 (*P. d.*) are included wherever possible [here I use the name *P. divisipilli* as a specific rather than a varietal name, since it appears possible that *P. insulare* (Berlese) 1910 and Feider's form may eventually prove to be distinct species]. Where superscripts are given, these indicate the number of measurements on which a given range and mean are based.

SUMMARY OF CHARACTERS AND VARIANTS IN ADULTS OF *Paratrombium*

1a. Sensilla smooth (Fig. 77).
1b. Sensilla distinctly barbed (Fig. 76).
2. Number of setae on each anterolateral lobe of scutum (from constriction anterior to area sensilligera to anterior extremity, and omitting the medial setae).
3a. Posterior end of crista metopica distinctly swollen (Fig. 20).
3b. Posterior end of crista metopica not swollen (Fig. 50).
4. Number of setae on each genital sclerite.
5. Number of setae on each paragenital sclerite.
6a. Row of denticles on tarsus of chelicera distinctly bent near the middle (Fig. 22).
6b. Row of denticles on tarsus of chelicera forming a straight line (Fig. 55).
7. Position of solenidion of palpal tarsus.
8. Number of eupathidia on palpal tarsus.
9. Length of tarsus I, female.
10. Height of tarsus I, female.
11. Length of tibia I, female.
12. Length/height, tarsus I, female.
13. Tarsus I/tibia I, female.
14a. Hysterosomal setae tapering uniformly, peripectinate (Figs. 3–7).
14b. Hysterosomal setae rounded distally, clavate, peripectinate (as in *Paratrombium insulare* Berlese 1910).
14c. Hysterosomal setae diclavate, i.e., essentially clavate, but deeply bifid (as in *P. divisipilli* Feider 1948).
15. Body length, by sex.

SUMMARY OF CHARACTERS AND VARIANTS IN LARVAE OF *Paratrombium*

1a. Postscutum with two setae in normal individuals.
1b. Postscutum with four setae in normal individuals.
2. Total number of postscutal and postcoxal setae.
3a. Palpal tarsus with only two minute, peglike setae terminally (oil immersion, Fig. 35).
3b. Palpal tarsus with four setae here (not distinct except in most favorable material).
4. Position of s_1.
5. Position of e_d on tarsus I.
6 Position of f_1.
7. Position of s_2.
8. Position of f_2.
9a. Posterior claw reduced to a minute vestige about 4 μ long.
9b. (Other variants?)
10. Length of scutum/length of postscutum.
11. Width of scutum/width of postscutum.
12. Width of postscutum/length of postscutum.
13. Width of scutum, μ.
14. Length of idiosoma of unengorged larva.

Paratrombium bidactylus, new species

FEMALE: Idiosoma 1820 μ long to tip of scutum, 1118 μ wide, length/width 1.63. Scutum (Fig. 20) widest at anterior end, the width equal to .62 of the *median* length. The

DISTRIBUTION OF CHARACTER VARIANTS, ADULTS

	1	2	3	4	5	6	7	8	9
P. b.	a	22–25	a	37–39	26–29	a	.87–.92	11	486–491 μ
P. q.	b	13–14	b	48–55	ca. 55	b	.80–.85	17–19	423 μ
P. d.	b	?	a	?	?	?	?	?	454–474 μ (462)

	10	11	12	13	14	15
P. b.	153 μ	261 μ	3.24	1.86–1.90	a	1820 μ*
P. *q.*	144–149 μ	261–266 μ	2.84–2.94	1.59–1.62	a	1768 μ*
P. d.	?	232–261 μ (252)	?	(1.83)	b	♀ 1638–1885 μ (1816) ♂ 1085–1740 μ (1402)

* Based on females which had laid full complement of eggs.

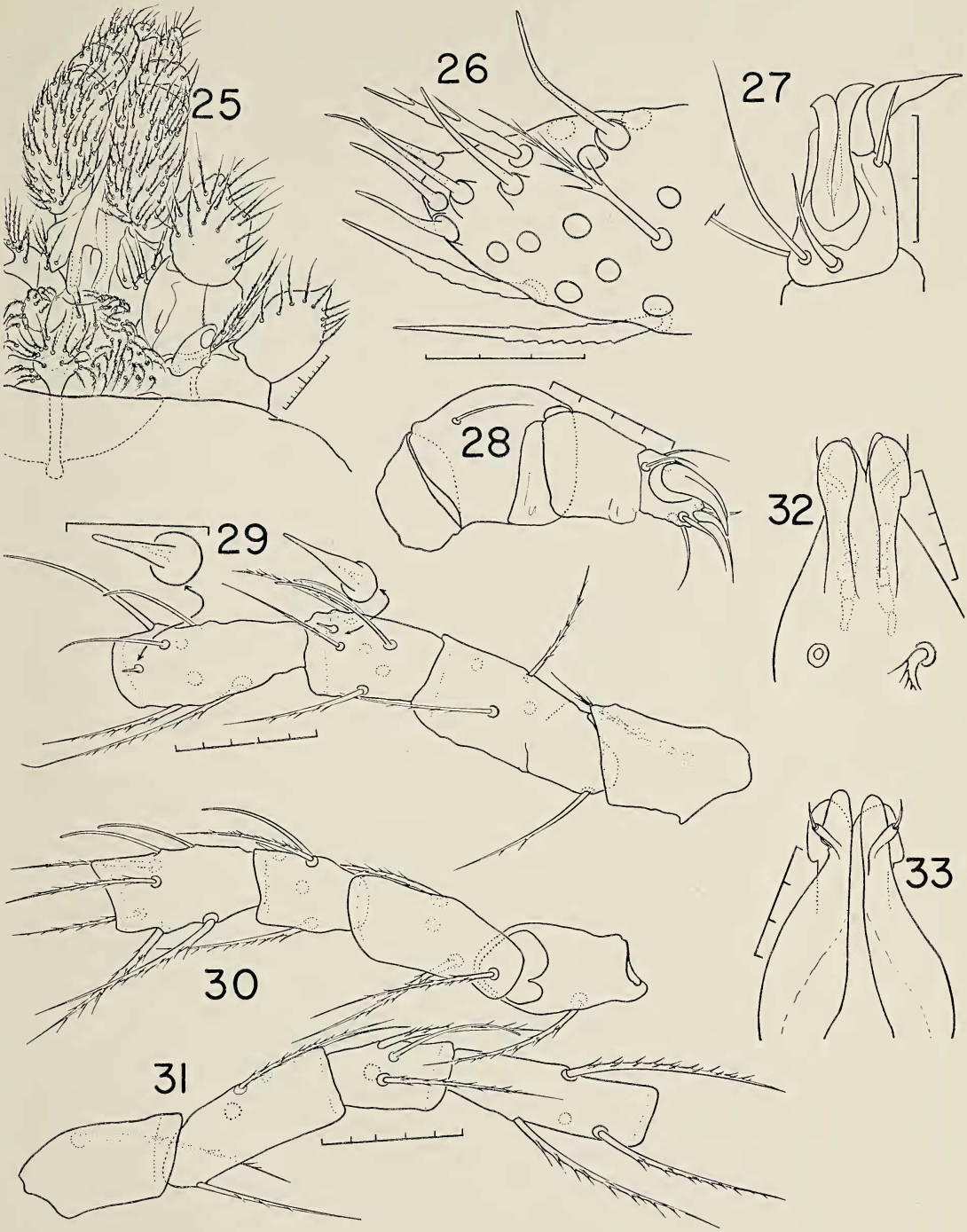
DISTRIBUTION OF CHARACTER VARIANTS, LARVAE

	1	2	3	4(s_1)	5(e_d)	6(f_1)	7(s_2)
P. b.	a	30	a	.47–.52(.49)[9]	.65–.71(.69)[9]	.45–.58(.53)[9]	.47–.54(.51)[10]
P. q.	b	32	b	.35–.48(.42)[10]	.64–.71(.66)[10]	.38–.55(.51)[10]	.40–.50(.45)[10]
P. d.	a	?	?	?	?	?	?

	8(f_2)	9	10	11	12	13	14
P. b.	.45–.55(.51)[10]	a	2.43[11]	1.09[11]	2.92[11]	216–236[11]	387–441 μ[10]
P. q.	.35–.49(.43)[10]	a	3.38[9]	1.23[9]	3.51[9]	188–208[9]	356–383 μ[5]
P. d.	?	a	2.76[1]	?	2.15	(compressed)	331–351 μ

anterolateral lobes of the scutum, extending from the anterior end to .21 are well developed, bearing 22 to 25 setae on each side, most of which are concentrated on the lateral arms. Sensilla situated at .39, appearing completely smooth even at magnifications of 1000× (oil immersion). Beginning at .32 and extending anteriorly is a deep furrow which widens gradually as it approaches the anterior margin of the scutum; at about .05 this furrow widens abruptly and disappears on the general surface of the scutum. In the specimen studied, there are three setae at the level at which the furrow disappears. Behind the constriction at .21, the scutum widens perceptibly around the area sensilligera and then tapers gradually toward the posterior end. At .79, the scutum is reduced to the thickness of the crista metopica alone. The crista is distinctly swollen between .90 and 1.0, with pigmented cuticle completely encircling the depression in the end of the crista. In the portion of the scutum between .21 and .79, there are 31 elongate peripectinate setae similar in form to those on the anterior portion of the scutum. In the specimen examined, 16 of these are on the left side and 15 on the right side. The marked indentation at .27 in the specimen from which Figure 20 was drawn was absent from the other side of the scutum. The elongate peripectinate setae on the surface of the propodosoma lateral to the scutum are borne on subconical papillae as are those on the hysterosoma. Ocular plates pedunculate, bicorneate. Anterior margin of hysterosoma projecting well beyond the posterior margin of the propodosoma so that the posterior portion of the scutum is hidden in dorsal view; setae along anterior margin of hysterosoma somewhat more slender and also smoother than those covering the rest of the body. Otherwise the setae of the hysterosoma are all of one type, heavily barbed, peripectinate, and the alveoli are at the apex of truncate conical papillae.

Setae of coxae I and II fairly stiff, peripectinate for about three-fourths their length, then smooth out to the usually rounded tips. Pars medialis coxae of rather unusual form, arising from inner angles of coxae I, and forming a narrow border about 15 μ wide around the convex inner angle of coxae II. The pars of right and left side are contiguous medially and may even appear to be fused in undissected specimens (Fig. 19). The pars medialis coxae contain 5 to 8 setae each, and because of their close approximation, the intercoxal area is completely isolated from the membranous cuticle behind the coxae; it contains between 25 and 40 closely packed peripectinate setae, somewhat shorter and thicker than the ones behind coxae II. Supracoxal seta slender, smooth; coxal ring of I and II both open dorsally. Membranous cuticle between coxae II and III apparently devoid of sclerites. Coxae III and IV as shown in Figure 24, coxal rings complete dorsally. No trace of a *Lassenia*-organ was seen at coxa III although the dense vestiture may have concealed it. Genital and paragenital sclerites both well developed (Fig. 2); genital sclerites with 48 to 55 peripectinate setae each, the paragenital sclerites with about 56 setae each. Most of the setae have four to six whorls of barbs



FIGS. 25–26. *Paratrombium bidactylus*, n. sp., female: 25, propodosoma, dorsal; 26, tarsus of palp, anterior.

FIGS. 27–33. *Paratrombium bidactylus*, n. sp., larva: 27, tibia and tarsus of palp, dorsal; 28, entire palp, anterior; 29, trochanter to tibia I; 30, trochanter to tibia II; 31, trochanter to tibia III; 32, tip of rostrum, ventral; 33, same, dorsal.

each, but one or two of the setae at the posterior end of the genital sclerites are very nearly smooth. Three pairs of genital acetabula placed well back in the genital opening, decreasing in size from anterior to posterior. Anal sclerites present, but so well concealed by surrounding setae that their form and chaetotaxy were not ascertainable. Ventral hysterosomal setae arising from truncate, conical sclerites (Fig. 3).

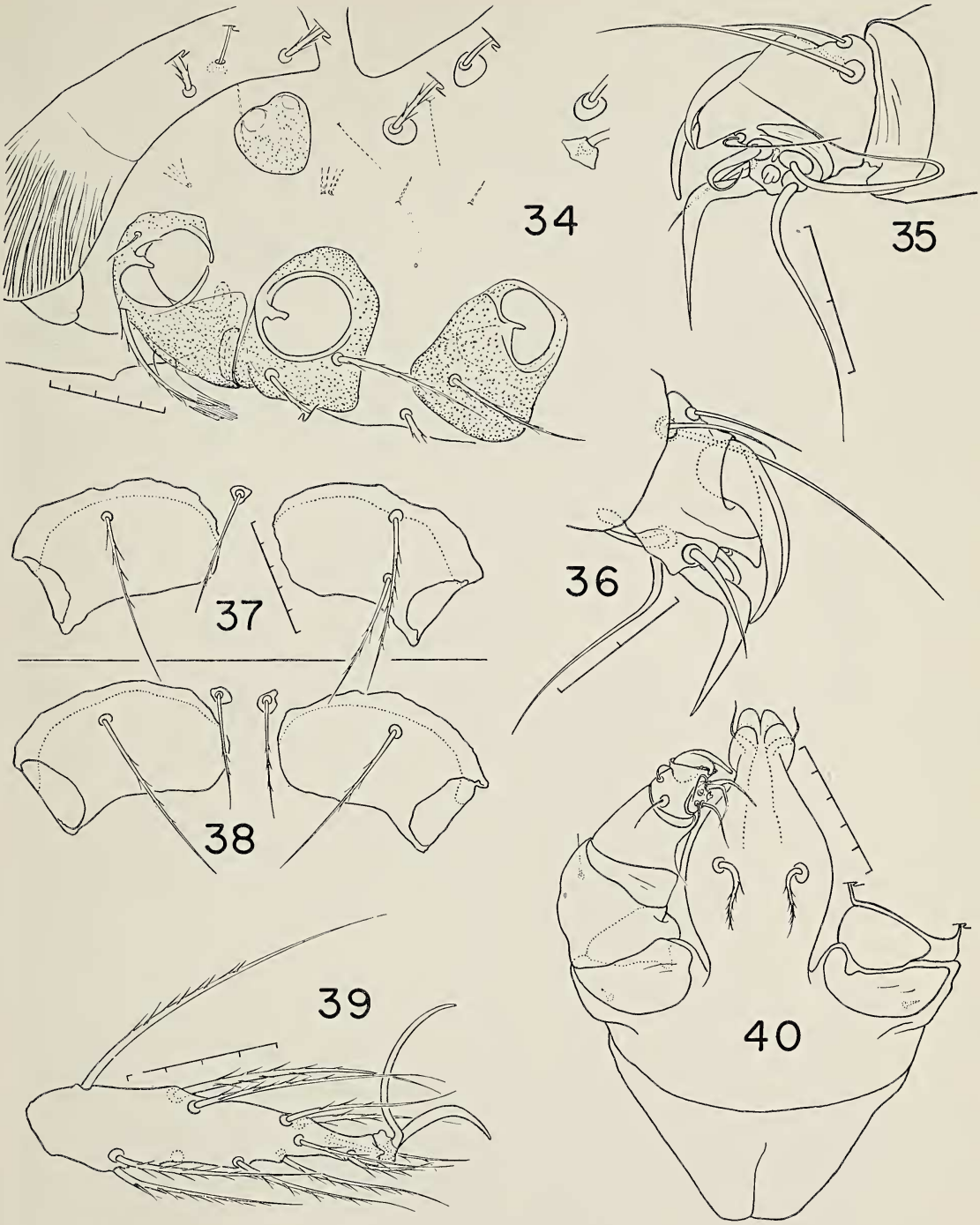
Base of gnathosoma with posterior ventral margin deeply concave; both base and rostrum with numerous curved, peripectinate setae. Velum simple, circular in outline, containing a central circlet of converging fimbriae. Four or five very slender, sparsely peripectinate setae arising from distidorsal surface of rostrum, and extending beyond the tip of the rostrum. Four or five setae arranged in a diagonal row posterolaterally to the velum. On the ventrolateral aspect of the rostrum are blunt setae, roughly rounded and smooth at the tips (Fig. 21).

Chelicerae (Figs. 22, 23) arched dorsally, fairly straight along the ventral margin. Dorsal membrane well developed and blunt. Tarsus of chelicerae with a row of 8 to 10 dorsal teeth in the distal half; at about the middle of the dorsal margin the row of teeth bends sharply down over the side of the tarsus where an additional 12 or 13 teeth of progressively diminishing size are found. Trochanter of palp with 9 or 10 elongate peripectinate setae in a fairly straight row down the posterior surface of the segment; anterior surface of trochanter bare, distal margin distinctly excavated. Odontus of tibia very heavy, undivided. Setae of tibia ranging from nearly smooth on anterior and posterior surfaces to very heavy and serrate along the dorsal margins. It is not known whether these setae are primarily serrate, or whether this condition arises as a result of a wearing or breaking off of the barbs. All of the setae of the tibia, with the exception of the odontus, are long, slender, and fairly flexible; no ctenidium is present. Each palpal tarsus in the specimen studied with 11 eupathidia ranging from .56 or .68*d* to .95 or .96*v*; the solenidia lie at .87 to .92*p* (one on each tarsus). The striated appearance of the solenidion is apparent only under favorable conditions.

Tarsus I 486–495 μ long, 153 μ high, length/height 3.24; tibia I 261 μ long, tarsus I/tibia I 1.86–1.90 (one specimen).

LARVA: Idiosoma (Figs. 41, 44) 387 to 441 μ long, 225 to 252 μ wide, length/width 1.73 to 1.88; average of 10 unengorged larvae 419 by 234 μ, length/width 1.80. Anterior margin of scutum truncate, with two heavy setae inserted dorsally just behind the margin; rostrum and palpi extending beyond the margin of the scutum. Just anterior to the level of coxa I is a prominent suture on either side of the scutum, these sutures not quite reaching to the lateral margin. Anterior to the sutures the margin of the scutum is characteristically marked by undulating striae. The remainder of the scutum is densely and uniformly punctate. Sensilla and the neighboring setae faintly barbed, the prosensillar setae completely smooth. Postscutum virtually as wide as the scutum (average ratio 1.09, 11 specimens), faintly punctate, bearing a pair of setae behind the middle of the plate. Ocular plates very small, bicorneate, completely lateral in position. Including the setae of the postscutum, there are 24 peripectinate dorsal and marginal setae; venter with 6 peripectinate postcoxal setae, making a total of 30 postcoxal and postscutal setae. Except for setae of postscutum, all these are borne on individual sclerites which bear a few punctae. Membranous cuticle appearing smooth at low magnifications, but faintly striate at higher magnifications.

Coxa I with a greatly enlarged rakelike seta anteromedially, bearing 10 to 15 digitiform teeth, identical in form with corresponding seta of *P. quadriseta* n. sp. (Fig. 63); anterolateral seta of coxa I elongate, slender, peripectinate. Coxa I with an elongate, sharp supracoxal seta; II and III without such a seta. Urstigma large. Coxae II and III sep-



FIGS. 34–40. *Paratrombium bidactylus*, n. sp., larva: 34, propodosoma, lateral, showing apodemes and *Lassenia*-organ; 35, tibia and tarsus of palp, posterior; 36, tibia and tarsus of palp, anterodorsal; 37, setal anomaly in coxa III; 38, normal chaetotaxy at level of coxa III; 39, tarsus III; 40, gnathosoma, ventral.

arated by a distinct interval of striated cuticle, bearing two and one setae respectively. Intercoxal area with a single pair of setae between III. In one specimen (Fig. 37) there was only one intercoxal seta, but coxa III of the left side bore a supernumerary seta in the posterolateral corner which evidently represented the displaced intercoxal seta. Postcoxal area with only three pairs of ventral and submarginal setae. Anal anlage very well developed. A small but distinct *Lassenia*-organ can be seen laterally between coxae II and III in good specimens; it is seen to best advantage in somewhat rotated individuals (Fig. 34). In the specimen drawn, the pore had a diameter of slightly more than 1 μ, and opened into a duct about 22 μ long, the inner end of which was slightly swollen. This is unquestionably the homologue of the same organ in *Lassenia* (Johnstonianidae) in which it is better developed. The function, if any, is unknown; it is not an apodeme.

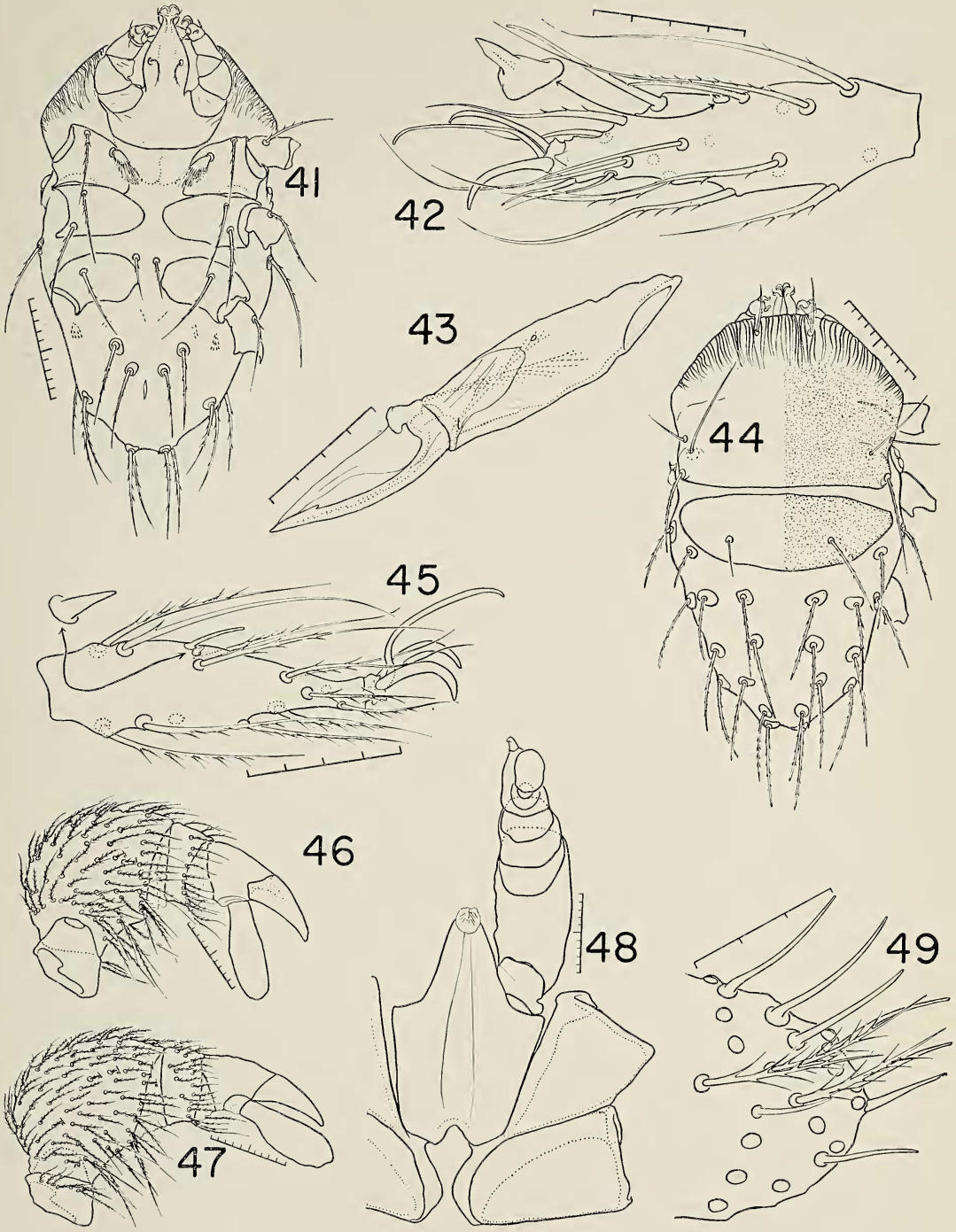
Base of gnathosoma with posterolateral margins converging to a rounded or truncate end posteriorly; devoid of setae, except for the minute spikelike supracoxal setae which are dorsal in position (Fig. 40). Protorostral setae smooth, inserted at the ends of a pair of characteristic tubular structures on the dorsal lobes of the velum. Deutorostral setae totally absent, tritorostral setae peripectinate, situated at about the widest part of the rostrum. Palpi five-segmented, but trochanter reduced to an ovate plate on the dorsal surface of the palp (see Fig. 72, *P. quadriseta*). The inner angle of the trochanter can be seen projecting beyond the anterior margin of the palp where at first it may appear to be a lobe on the femur (in Figure 40, the ventral portion of the left femur has been deleted to show the position of the trochanter). Femur with a smooth seta on dorsal surface, quite variable in position. Patella without setae. Tibia with three smooth setae plus the deeply cleft odontus; no specialized paradont. Tarsus reduced to a small cap on the anterior aspect of the tibia bearing only 7 setae (Fig. 35). These include the large apical L-shaped seta (possibly a modified eupathid?) plus 5 other normal setae of varying lengths and thicknesses. In the center is a minute peglike solenidion scarcely discernible even under oil immersion, plus one other seta of similar form. The palpi of this species are remarkable for the geniculate form, which considerably alters the normal morphological relationship of the palpi with the rostrum. The morphological dorsal line forms the lateral margin of the palp as seen in ventral or dorsal view.

Chaetotaxy of legs approximately as shown in table (s = solenidia, e = eupathidia, f = famulus, v = vestigial setae, c = companion setae, n = normal setae).

	tr	fe	pa			ti			ta				
	n	n	s	v	n	s	v	n	s	e	f	n	c
I	1	5, 6	2	1	4	2	1	5	1	2	1	17	0
II	1	4	1	1	3	2	0	5	1	0	1	14	0
III	1	4	1	0	3	0	0	5	0	0	0	13	0

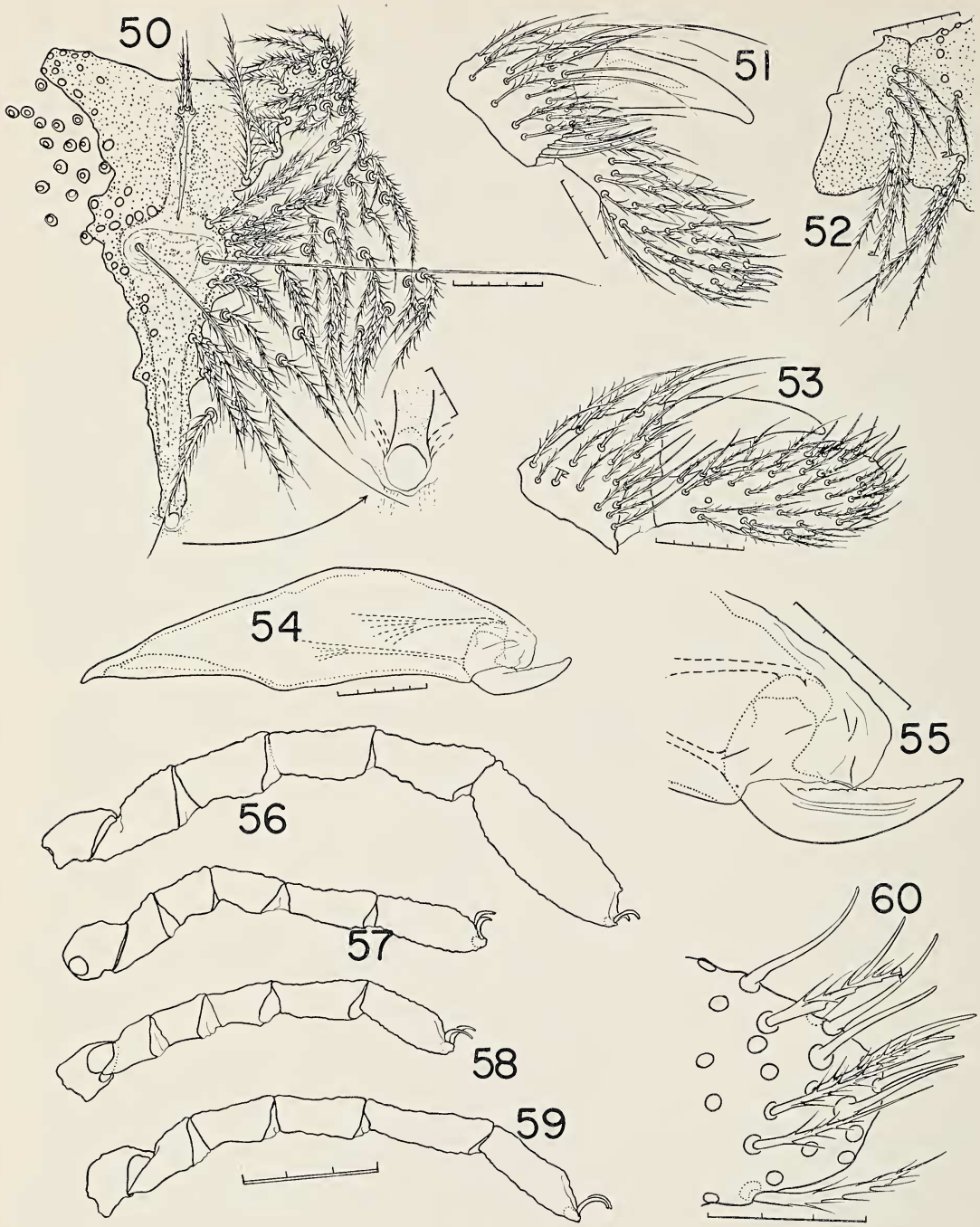
Basifemur and telofemur of all legs fused. Patella I with solenidia at .28 and .45*d*, II and III with solenidia at .34 and .39*d*, respectively. Patella I and II each with a solenidion at .79 and .77*d*, respectively. Tibia I with solenidia at .56 and .75*d*, a vestigial seta at .90*pd;* II with solenidia at .39 and .56. The solenidia of the tibia show no readily perceptible difference in form. Tarsus I with S_1 at .47 to .52, a dorsal eupathid (e_d) at .65 to .71*d*, and a famulus at .45*d* to .58*d*. Tarsus II with S_2 at .47 to .54*pd* and f_2 at .45–.55; III with no specialized setae. Other chaetotactic features as shown in table. Tarsi I and II with three claws each, the median claw more slender than the anterior and posterior claws; III with posterior claw reduced to a minute vestige about 4 μ in length as in the case of *P. quadriseta* n. sp. (Fig. 74).

TYPE LOCALITY: Sherwood Creek, Mason



FIGS. 41–45. *Paratrombium bidactylus*, n. sp., larva: 41, venter; 42, tarsus I, posterior; 43, chelicera; 44, dorsum; 45, tarsus II, posterior.

FIGS. 46–49. *Paratrombium quadriseta*, n. sp., female: 46, palp, anterior; 47, palp, posterior; 48, outline of propodosoma and gnathosoma, ventral; 49, detail of end of palpal tarsus, posterior.



FIGS. 50–60. *Paratrombium quadriseta*, n. sp., female: 50, scutum of dissected specimen; 51, tibia and tarsus of palp, anterior; 52, trochanter of palp, posterior; 53, tibia and tarsus of palp, posterior; 54, chelicera; 55, tarsus of chelicera; 56–59, legs I–IV; 60, tip of palpal tarsus, anterior.

County, Washington. Sandy mud, in grass. July 27, 1954. Collected by the writer. At the point where this species was found, Sherwood Creek is estuarine, opening into Case Inlet of Puget Sound. The mites were collected on a low mound which was nearly covered by high tide.

REMARKS: The correlation between the larva and adult described above was established by rearing from eggs laid by the female collected at the type locality.

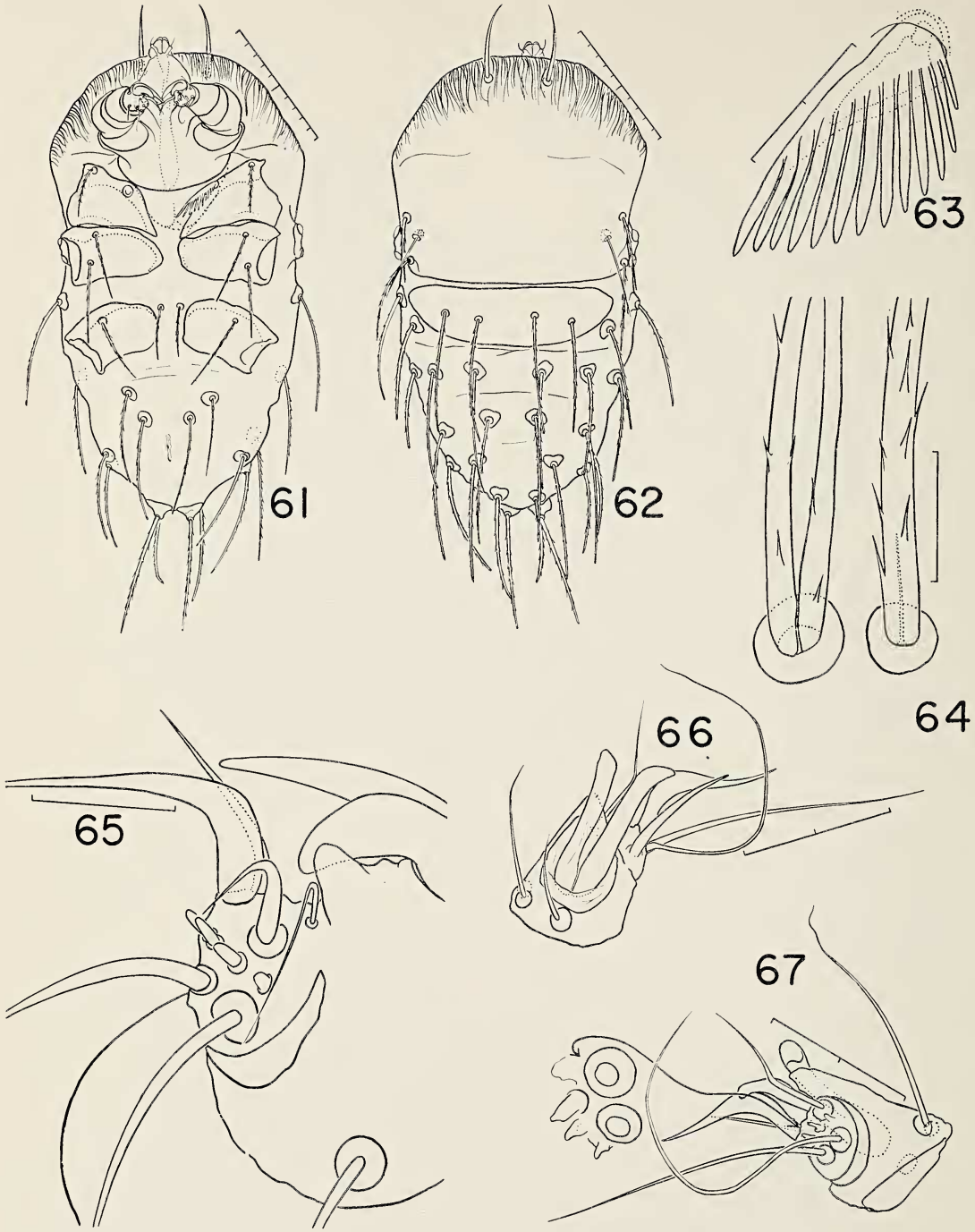
The relationship of this species to described forms is somewhat obscure, but there is no doubt that it is congeneric with *P. quadriseta* n. sp. The adult keys out with some slight inconsistencies to the genus *Caenothrombium* Oudemans, 1927, and agrees with the type of that genus in a number of details, including the general form of the crista, the double, stalked eyes and the absence of a distinct ctenidium on the tibia of the palp (there is definitely no distinct ctenidium in *P. b.* and *apparently* none in *C. caloris*). However, the larva does not appear to be congeneric with the larva of *C. miniatum* Womersley, 1934, for which species Womersley has established a correlation. Differences, as far as can be judged from Womersley's figures of this larva (1939*a:* 156), are in the chaetotaxy of the scutum, the absence of the heavy comblike seta of coxa I and the undivided (?) odontus. The drawings in the original description of the larva are not complete, but they probably are fairly accurate in these three respects. The larva of *P. bidactylus* keys out to the third dichotomy in the key given by Thor and Willmann (1947: 484). At this point further separation was made on the basis of the claws of tarsus III—whether these are normal, or whether the posterior claw (inner-claw) is deformed. Neither of these fits *P. bidactylus* or *P. quadriseta* accurately, and the key, as well as the diagnosis of the genus given by Thor and Willmann, were in error on this point. The fourth dichotomy of that key is totally unreliable since it is based upon the presence or absence of setigerous sclerites behind the postscutum. It is quite likely that these have been overlooked by many authors in describing their species because of refractive index difficulties.

An examination of the drawings of the larva of *P. egregium* presented by Bruyant, Oudemans, and Thor and Willmann shows a close similarity between *P. bidactylus* and *P. egregium* Bruyant, 1910. The similarity is indicated in the shape of the scutum, the form of the prosensillar setae and their insertion at the ends of long canals, the heavy pectinate tritorostral setae, the comblike seta of coxa I and the chaetotaxy of the body, especially the ventral setae. These forms are extremely similar, and the resemblance is far too close to be a consequence of convergence; hence we can assume that they are actually very closely related.

The foregoing discussion leaves a number of important questions. For one thing, is the genus *Caenothrombium* made up of generically related species, or is it a composite? Was Womersley correct in assigning his *Caenothrombium miniatum* to that genus? Was the female which laid the eggs from which Womersley described the larva actually *C. miniatum* or a different species? There seems to be no way in which these questions can be resolved by reference to the literature, so further speculation about them is pointless.

Paratrombium quadriseta, new species

FEMALE: Idiosoma, 1,768 μ long to tip of scutum, 1,092 μ wide, length/width 1.62. Scutum of dissected female (Fig. 50) resembling that of *P. bidactylus* in most details. However, the anterolateral lobes of the scutum, extending from about .25 to the anterior limits of the scutum bear only 13 to 14 setae on each side (*P. b.:* 22 to 25 setae on each side). In the present species there is a wide interval between the three anteromedian setae and those more laterally placed, whereas in *P. bidactylus*, this wide gap was not found. Width of scutum equal to .67 of the *median* length. Sensilla situated at .40, appearing



FIGS. 61–67. *Paratrombium quadriseta*, n. sp., larva: 61, venter; 62, dorsum; 63, medial seta of coxa I; 64, anomalous postscutal seta and normal homologue; 65, tibia and tarsus of palp, posterior; 66, tibia and tarsus of palp, dorsal; 67, tibia and tarsus of palp, posteroventral.

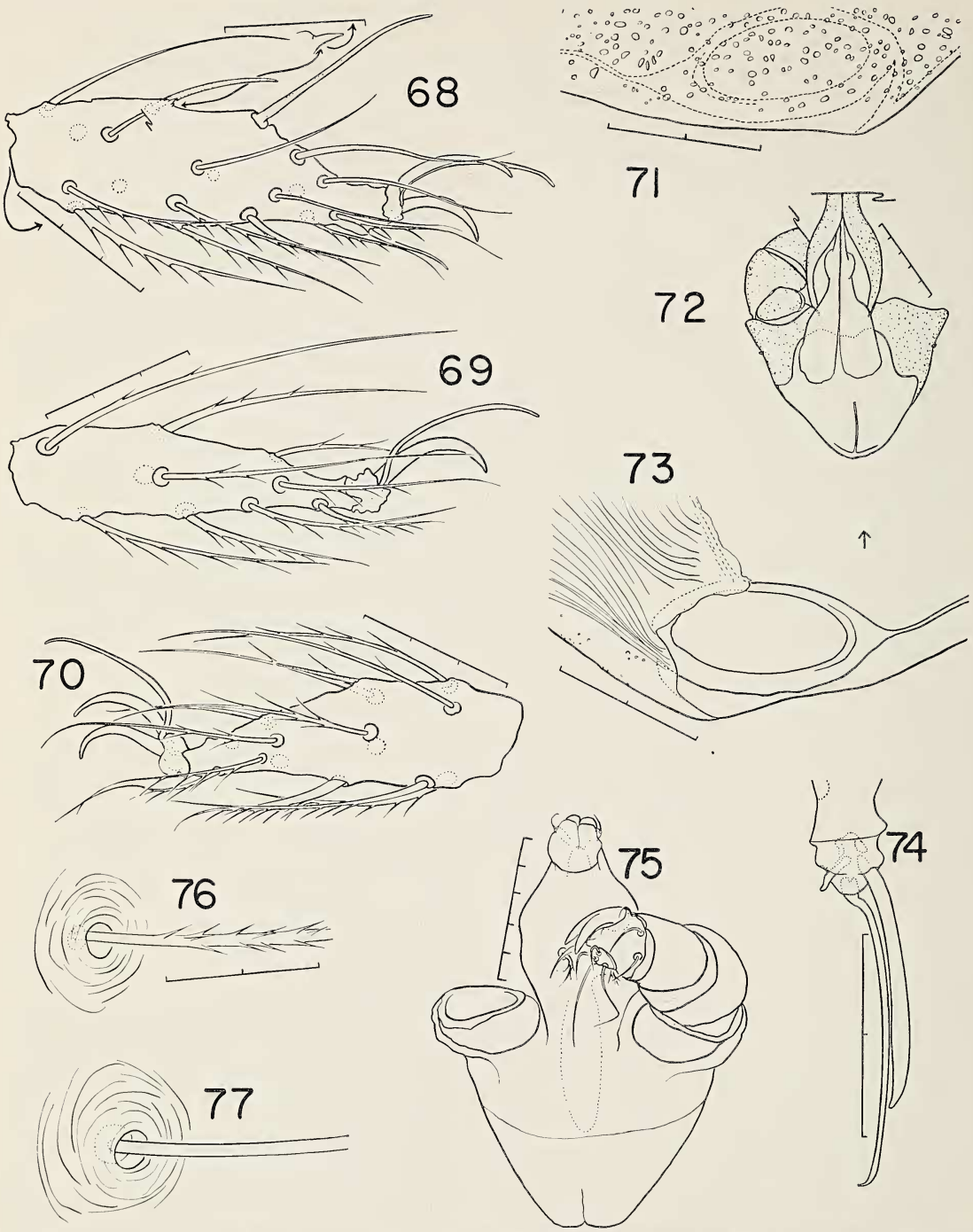
minutely barbed at magnifications of 600 × (Fig. 76). Beginning at .32 and extending anteriorly is a deep furrow, reaching to the level of about .08; beyond this level are three setae as in the previous species. Narrowest point of scutum at .22 to .27. Punctate cuticle extending very nearly to the posterior end of the scutum, which is not markedly swollen as in *P. bidactylus*, and the pigmented cuticle ends in front of the depression in the end of the crista. In the portion of the scutum between .25 and .68 of the specimen examined, there were 30 setae, 15 on each side (*P. b.*: 31 setae here, in the one specimen). Crista metopica tapering somewhat more gradually behind area sensilligera than in preceding species. Ocular plates and dorsal hysterosomal setae as in *P. bidactylus*.

Ventral surface of the body showing no significant differences from *P. bidactylus*, except for a slightly more sparse vestiture of the coxae and genital sclerites. Genital sclerites bearing 39 and 37 setae (*P. b.*:48–55), paragenital sclerites bearing 26 and 29 setae (*P. b.*: about 55 on each side). The form of these setae is essentially identical in the two species, however. Gnathosoma in ventral view resembling that of *P. bidactylus*, but slightly larger; rostrum not reaching to distiventral margin of femur (in *P. bidactylus* the rostrum extends to a point about half way between the distiventral and distidorsal margins of the segment).

Chelicerae virtually identical with those of *P. bidactylus*, except that the row of denticles is straight throughout its length, whereas in the preceding species it is sharply deflected about the middle. Palpi virtually identical in general size and form with those of the preceding species. Tibia with large unidentate odontus but without paradont. One feebly developed ctenidium present, consisting of about four setae somewhat longer, heavier, and smoother than the others, extending along the anteroventral margin at the insertion of the tarsus. Eupathidia of tarsus extending from .68*d* to .95*v*, solenidion at .80 to .85*p*. The eupathidia of the palpal tarsus of this species are noticeably more numerous (17–19) than in *P. bidactylus* which has only 11 on each tarsus. With such a difference as this, it is doubtful that study of larger numbers of individuals would show much overlapping in this character.

Tarsus I 423 μ long, 144–149 μ high, length/height 2.84–2.94; tibia I 261–266 μ long, tarsus I/tibia I 1.59–1.62 (single specimen).

LARVA: Idiosoma (Figs. 61, 62) 356 to 383 μ long, 189 to 203 μ wide, length/width 1.87 to 1.92; average 374 μ by 197 μ, length/width 1.88 (five unengorged larvae). Scutum essentially as in *Paratrombium bidactylus;* prosensillar setae completely smooth, somewhat spindle-shaped, with thickest portion about one-fourth of the way out on the shaft. Anterior portion of scutum striate, posterior portion densely and uniformly punctate. Sensilla appearing smooth at low magnifications but faintly pectinate under higher magnifications. Ocular plates bicorneate, the anterior cornea larger than the posterior. Postscutum bearing four setae in a transverse row. (In some individuals of *P. bidactylus*, one of the setae of the postscutum may be duplicated, but in these cases the placement of the supernumerary seta is quite different since it is not aligned with the two normal setae.) Remaining dorsal and marginal setae identical in number and position with those of *P. bidactylus*, so that there is a total of 26; venter with 6 peripectinate postcoxal setae, making a total of 32 postcoxal and postscutal setae. Except for the setae of the postscutum, all of the setae are borne on individual punctate sclerites. Membranous cuticle faintly striate, but the striae do not make any striking pattern. Ventral surface showing no significant difference from *P. bidactylus*. One dissection provided considerable insight into the structure of the so-called urstigma (or "urpore"). In Figure 73 (dorsal view) the urstigma is seen to consist of an elliptical cavity or ring, with no opening whatever on the ventral sur-



FIGS. 68–75. *Paratrombium quadriseta*, n. sp., larva: 68, tarsus I, posterior; 69, tarsus III; 70, tarsus II; 71, urstigma, left coxa I, ventral; 72, outline of gnathosoma, dorsal; 73, urstigma, detached coxa I, dorsal; 74, tarsal claws III, right side, dorsal; 75, gnathosoma, ventral.

FIG. 76. *Paratrombium quadriseta*, n. sp., female, base of sensillum.

FIG. 77. *Paratrombium bidactylus*, n. sp., female, base of sensillum.

face (Fig. 71). The posterior wall of the urstigma lies in a slitlike pouch between the posterior margin of coxa I and the overlying membranous cuticle of the ventral body wall. An apodeme arises from the anterior margin and extends in an anterior direction. The punctate cuticle posterolateral to the urstigma in Figure 73 is the upturned margin of coxa I which continues directly with the striated membranous cuticle of the body wall. Although the function of the urstigma is not apparent from this, it obviously is not a respiratory opening. The term "urpore" is a misnomer, but "urstigma" appears to be acceptable as long as it is understood that it is not a "stigma" in the sense of a respiratory opening. Details of lateral portion of propodosoma as shown for *P. bidactylus* (Fig. 34). Base of gnathosoma as described for *P. bidactylus*, except that the supracoxal setae appear to be consistently more lateral in position, and also shorter and blunter. Palpi as in previously described species, except for chaetotaxy of tarsus. The tarsus bears four long setae dorsally, one of which is very slender, another heavy and scythe-shaped, and the other two intermediate in form. The two ventral setae are flexible and very elongate. Between the four dorsal and two ventral setae is a transverse row of four short, peglike setae. One of these is presumably the solenidion, probably the most posterior one, but all four are so similar in form and size that it is impossible to say for certain which one is the true solenidion. Podocephalic canals very short, extending scarcely to the level of the anterior margin of coxa I. Rostrum as in *P. bidactylus*.

Although the larva of *P. bidactylus* is larger than that of *P. quadriseta*, its palpal tarsus appears to be both actually and relatively smaller. In one specimen of each of the two species, the maximum diameter of the base of the tarsus measured 10 and 13 μ respectively, which is a considerable difference in a structure of this small size. In *P. quadriseta*, four small setae can be resolved with little or no difficulty, arranged in a straight row across the distiventral surface of the tarsus. In *P. bidactylus* on the other hand, only two setae can be seen with any certainty here, and these are noticeably compressed between the bases of the larger setae and the tarsus (Figs. 35, 67).

Femora I–III undivided, basiventral seta of all femora very delicate, only about half the diameter of the other setae on the segment. Chaetotaxy of legs similar to that of *P. bidactylus*, at least so far as the number of setae on the various segments is concerned. Solenidia of patella I at .37*d* and .54*d*, vestigial seta at .80*d*. Tibia I with solenidia at .50*d* and .74*d*, a vestigial seta at .88*d*. Tarsus I with solenidion at .35–.48*d*, e_d at .64–.71, and e_p at 0.94, famulus at .38–.55. Patella II with a single solenidion at .40, vestigial seta at .73; tibia with two solenidia, at .39*d* and .61*d*. Tarsus II with solenidion at .40–.50*d*, famulus at .35–.49*d*; eupathidia lacking. Patella III with solenidion at .47, tibia without solenidia. Tarsus III typically bears four whorls of normal setae containing three, four, four, and two setae each (total 13), but of 8 tarsi examined, two had 14 normal setae and one had 12 normal setae. The basal whorl normally contains only three setae, but in exceptional specimens a fourth has been added. In that tarsus III with only 12 setae, the deletion occurred in the third whorl from the base of the tarsus. Tarsi I and II each has three well-developed claws, the median one more delicate and erect than the anterior and posterior claws. Tarsus III with anterior and median claw well developed, posterior claw as in *P. bidactylus*, reduced to a very minute rudiment.

TYPE LOCALITY: Riverside, California, Santa Ana River, at Camp Evans. Females found crawling on muddy bank of stream, April 23, 1955. Collected by the writer.

REMARKS: The correlation between the larva and adult of this species was established by rearing. This species is obviously closely related to *Paratrombium bidactylus*, but the dif-

ferences between them appear to be of truly specific nature. They can be differentiated immediately on the basis of the chaetotaxy of the postscutum. In view of the variation noted in *P. bidactylus* it should be expected that exceptional forms might be found which have four setae on the postscutum, although none has been seen by the writer. However, even if this were to occur, the position of the lateral setae in *P. quadriseta* is very characteristic, these forming nearly a straight line with the medial setae. There are other differences too, of a more relative nature, in the proportions of the scutum and postscutum and the positions occupied by the specialized setae of tarsi I and II. These are summarized in the preceding table of variants of larval characters.

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